Planetary Science Division Status Report

Jim Green
NASA, Planetary Science Division
December 14, 2017

Presentation at AGU

PSD Personnel at AGU

Jim Green
Jim Watzin

Diane Brown
Laurie Cantillo
Doris Daou
Lindsay Hays
Michael Meyer
Marc Neveu
Michael New
Sarah Noble
Adriana Ocampo
Meagan Thompson

Planetary Science Missions Events

2016

March – Launch of ESA's *ExoMars Trace Gas Orbiter*
July 4 – *Juno* inserted in Jupiter orbit
September 8 – Launch of Asteroid mission *OSIRIS – REx* to asteroid Bennu
September 30 – Landing *Rosetta* on comet CG
October 19 – *ExoMars EDM* landing and *TGO* orbit insertion

*** Completed**

2017

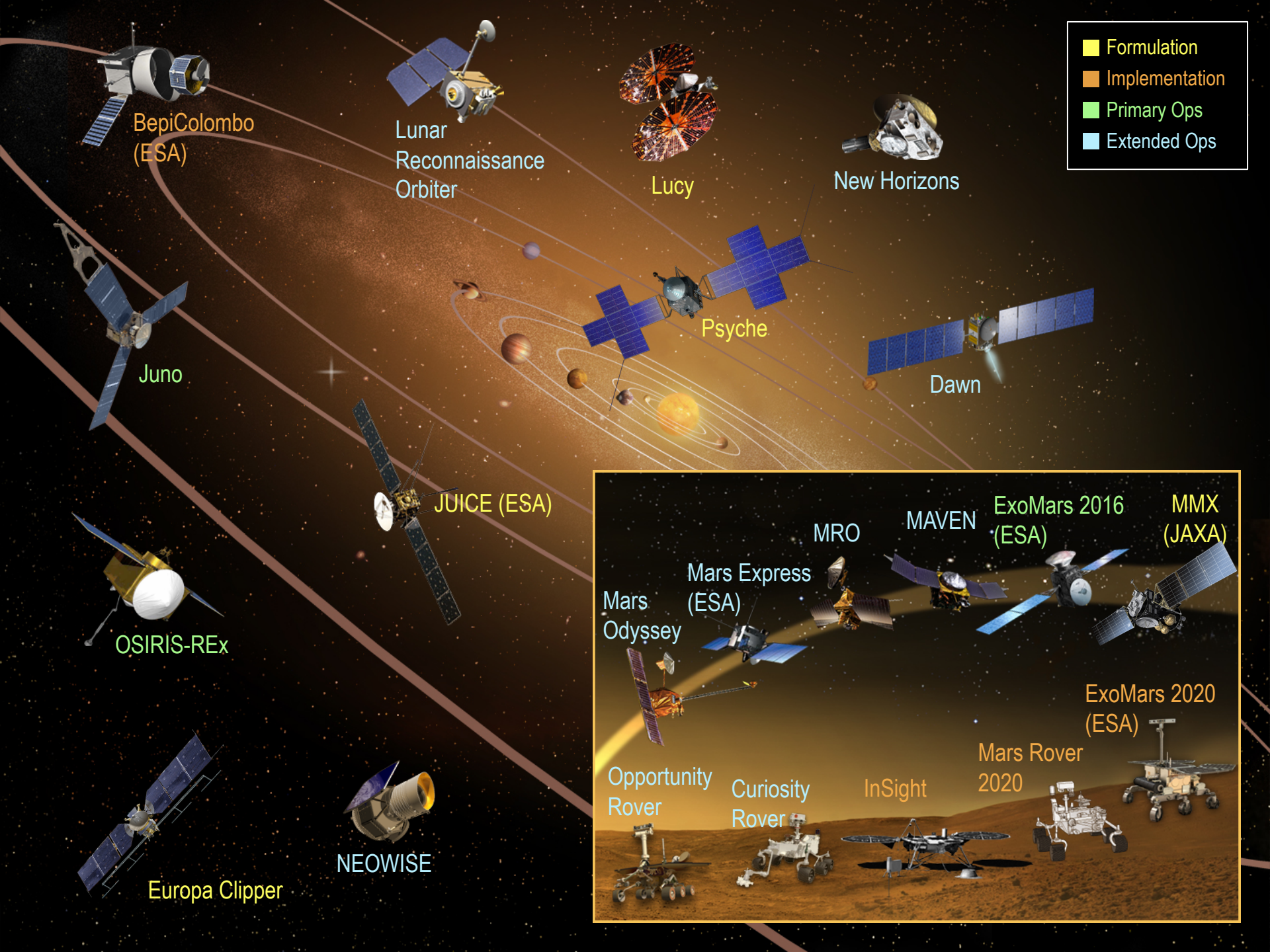
January 4 – Discovery Mission selection announced
February 9-20 - *OSIRIS-REx* began Earth-Trojan search
April 22 – *Cassini* begins plane change maneuver for the "Grand Finale"
August 21 – Solar Eclipse across America
September 15 – *Cassini* end of mission at Saturn
September 22 – *OSIRIS-REx* Earth flyby
October 28 – International Observe the Moon night (1st quarter)

2018

May 5 - Launch *InSight* mission to Mars
August – *OSIRIS-REx* arrival at Bennu
October – Launch of ESA's *BepiColombo* to Mercury
November 26 – *InSight* landing on Mars

2019

January 1 – *New Horizons* flyby of Kuiper Belt object 2014MU69


Formulation
Implementation
Primary Ops
Extended Ops
BepiColombo (ESA)
Lunar Reconnaissance Orbiter
Lucy
New Horizons
Juno
Psyche
Dawn
JUICE (ESA)
OSIRIS-REx
Europa Clipper
NEOWISE
MRO
MAVEN
ExoMars 2016 (ESA)
MMX (JAXA)
Mars Express (ESA)
Mars Odyssey
ExoMars 2020 (ESA)
Mars Rover 2020
Opportunity Rover
Curiosity Rover
InSight

Open Science Positions In SMD

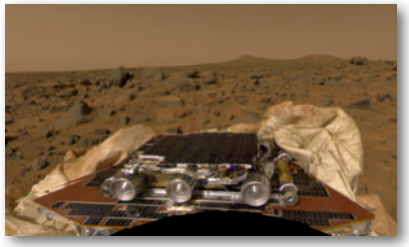
- AST, Science Program Management at NASA HQ
  - Salary Range: $112,021 - $161,900 (GS14 - GS15)
- Senior NASA scientists responsible for overseeing execution of major missions:
  - Astro: Open to all areas of space-based astrophysics
  - Planetary: Emphasis on exploration of and the search for life on ocean worlds
- Applications accepted only through USAJOBS.gov
  - Schedule: Open 1/2/18 to 1/31/18
  - NASA Announcement Number: HQ18C0015
  - Interested scientists should familiarize themselves with USAJobs.gov and begin to develop their resume and application within the USAJobs.gov system
- To apply see: USAJobs.gov when the job opens

Discovery Program

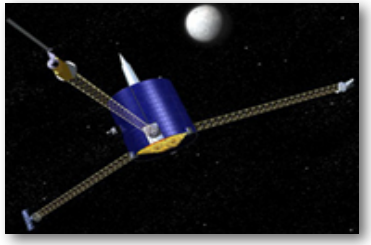
Discovery Program

NEO characteristics: NEAR (1996-1999)

Mars evolution: Mars Pathfinder (1996-1997)

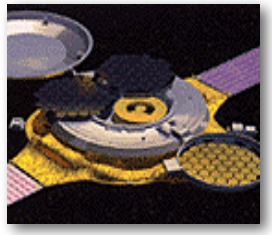


Lunar formation: Lunar Prospector (1998-1999)

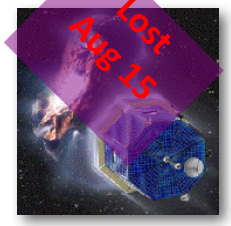


Nature of dust/coma: Stardust (1999-2011)

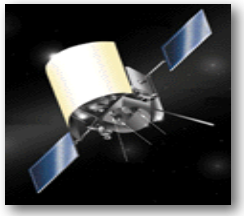
Solar wind sampling: Genesis (2001-2004)



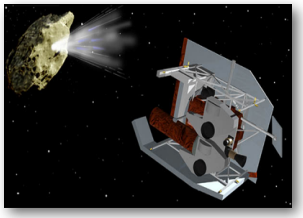
Comet Diversity: CONTOUR (2002)



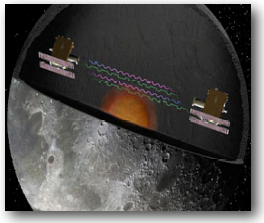
Mercury Environment: MESSENGER (2004-*2015*)



Comet Internal Structure: Deep Impact (2005-2012)



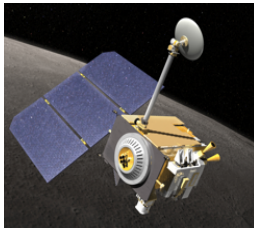
Lunar Internal Structure GRAIL (2011-2012)



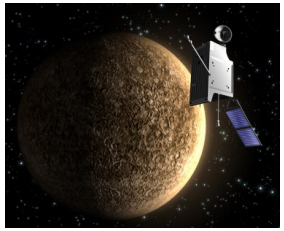
Main-belt Asteroids: Dawn (2007-*TBD*)

Exoplanets Kepler (2009-TBD)

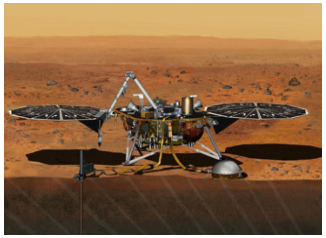
Lunar Surface: LRO (2009-*TBD*)



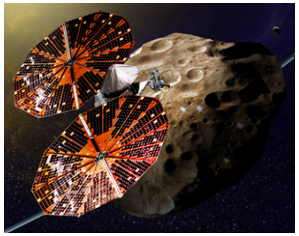
ESA/Mercury Surface: Strofio (*2017-TBD*)



Mars Interior: InSight (*2018*)



Trojan Asteroids: Lucy (*2021*)



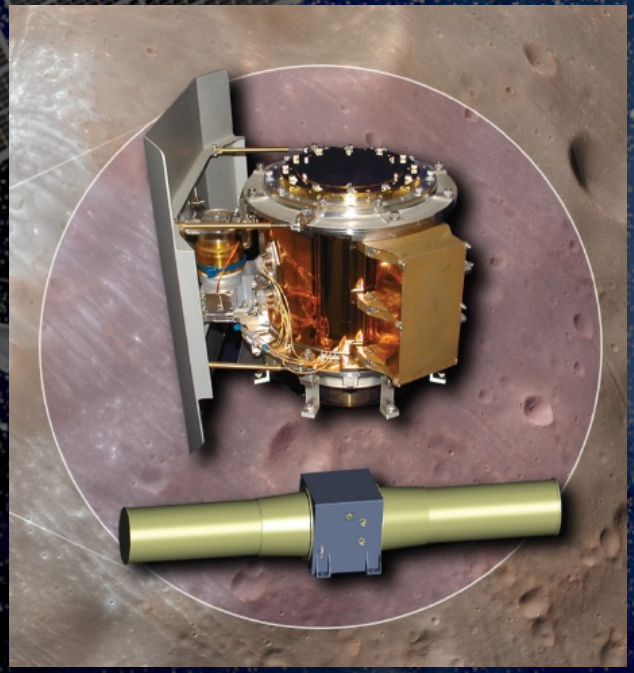
Metal Asteroids: Psyche (*2022*)

Martian Moons: MMX/MEGANE (*2024*)

JAXA Martian Moons eXploration (MMX) Mission Neutron & Gamma-Ray Spectrograph

- Solicited by NASA through the SALMON-3 AO
- Selection Announced Nov 16, 2017:
  MEGANE (“eyeglasses”)
  David Lawrence (JHU APL), PI

- Cryocooled high-purity Germanium γ-ray detector (MESSENGER GRS heritage)
- ^{3}He proportional counter neutron detector (Lunar Prospector heritage)



New Frontiers Program

New Frontiers Program

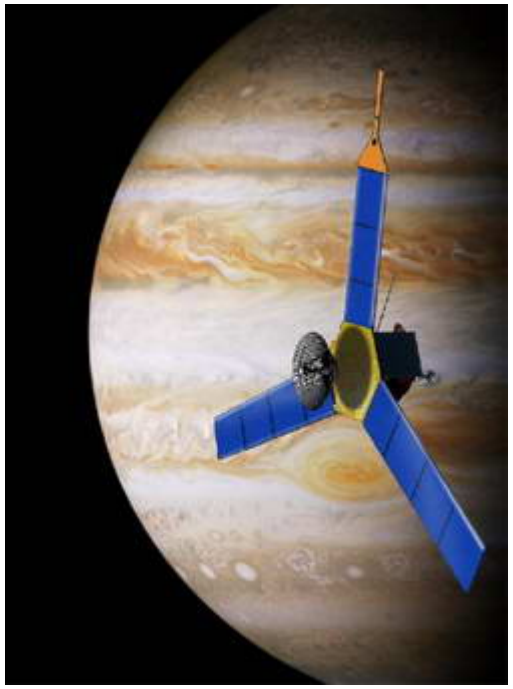
1st NF mission
New Horizons:

Pluto-Kuiper Belt

Launched January 2006
Flyby July 14, 2015
PI: Alan Stern (SwRI-CO)

2nd NF mission
Juno:

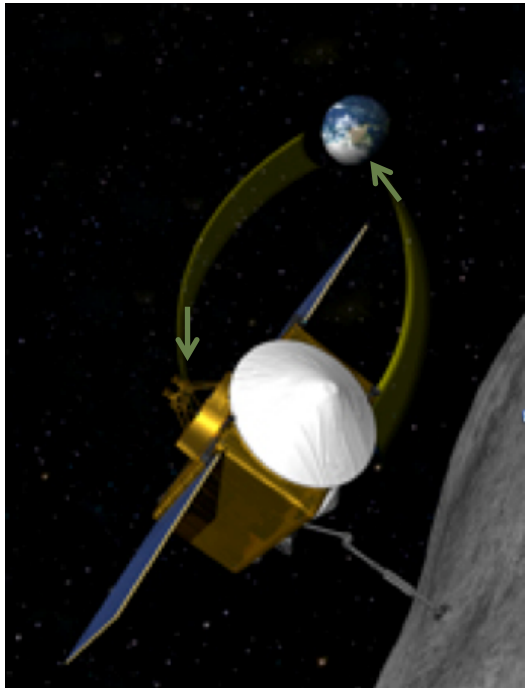
Jupiter Polar Orbiter



Launched August 2011
Arrived July 4, 2016
PI: Scott Bolton (SwRI-TX)

3rd NF mission
OSIRIS-REx:

Asteroid Sample Return



Launched September 2016
PI: Dante Lauretta (UA)

New Frontiers 4 AO

Investigations (listed without priority):

- Comet Surface Sample Return
- Lunar South Pole-Aitken Basin Sample Return
- Ocean Worlds (Titan, Enceladus)
- Saturn Probe
- Trojan Tour and Rendezvous
- Venus In Situ Explorer

12 Proposals received on ..... April 28, 2017

Step-1 Selections Announced (target)..... December 2017

Phase A Concept Study Reports due..... January 2019

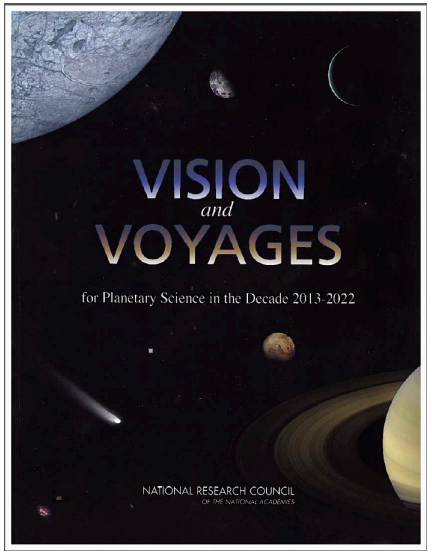
Down selection for Flight (target)..... July 2019

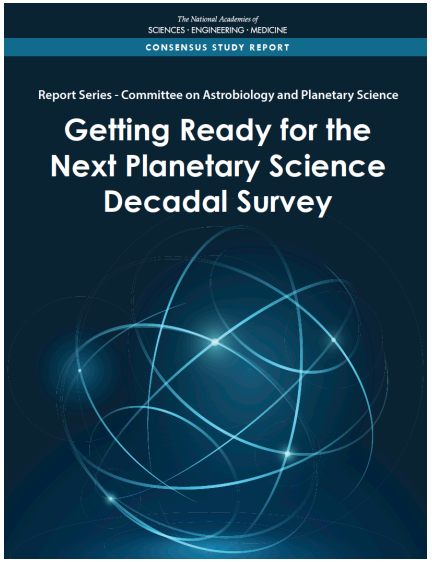
Launch Readiness Date..... NLT Dec. 31, 2025

National Academy of Science Studies for NASA's Planetary Science

Timeline of Studies

- 1st Planetary decadal: 2002-2012
- 2nd Planetary decadal: 2013-2022
- CubeSat Review: Completed June 2016
- Extended Missions Review: Completed Sept 2016
- R&A Restructuring Review: Completed June 2017
- Searching For Life : Completed Sept 2017
- Large Strategic Science Missions: Completed Aug 2017
- Midterm evaluation:
  - Tasked August 26, 2016
  - Above NAS studies will be input
  - Expect report to NASA due ~March 2018
- NEW: Sample Analysis Investment Strategy
  - Started November 2017
- 3rd Planetary Decadal: 2023-2032
  - To be tasked *before* October 2019
  - Expect report to NASA due 1st quarter 2022
- CAPS reviewed completed studies and recommended several more to be completed





Mission Studies Completed Thus Far

- Mars orbiter
  - 2015 MEPAG's Next Orbiter Science Analysis Group
- Uranus and Neptune (Ice Giants) system missions
  - 2017 NASA science definition team report
- Europa lander
  - 2017 NASA science definition team report
- Venus orbiter and lander (Venera-D)
  - 2017 joint U.S.-Russian science definition team report

CAPS Priority Areas Candidates for Large or Medium Class Mission Studies (Unprioritized)

Venus exploration missions	Additional concepts beyond the Venera-D orbiter and lander
Lunar science missions	Understanding interior processes and polar volatiles (Volatiles SAT Team-2)
Mars sample-return next-step missions	Mission elements beyond Mars 2020 necessary for second and third phases of a Mars sample-return campaign
Mars medium-class missions	Multiple mobile explorers, polar explorers, & life-detection. Investigations responsive to new discoveries
Dwarf planet missions	Large- & medium-class mission concepts to Ceres, Pluto, Triton
Io science (NEW FRONTIERS FIVE)	Reexamine mission to Io
Saturn system missions	Affordable, large strategic missions that visit multiple targets
Dedicated space telescope for solar system science	Dynamic phenomena on planetary bodies

Ceres Pre-Decadal Study

- CAPS highlighted Ceres for pre-decadal study
- Dawn revealed Ceres to be an active dwarf planet; It is a solid body, but is it a relic ocean world?
- PSD has directed JPL to lead the Ceres study; Michael Kelley is the PSD POC
- Goals are to assess science priorities and examine trade space of mission concepts
  - Spectrum of alternatives, including NF and Flagship
  - Orbiting, landing, roving, sample return?
  - Launch dates between 2024 – 2037
  - PP to be noted, uncover technologies to be addressed
- Key dates:
  - SDT call for applications issued via NSPIRES email list; responses due by December 21st
  - Design study January – Late FY18
  - Engagement with AGs and workshops/conferences

PSD CubeSats/SmallSats

Planetary Science Deep Space SmallSat Studies: Awards

Venus	Concept Title
	CUVE - CubeSat UV Experiment
	Seismicity Investigation on Venus Using Airglow Measurements
	Seismic and Atmospheric Exploration of Venus (SAEVe)
	Cupid's Arrow
Moon	
	Innovative Strategies for Lunar Surface Exploration
	Lunar Water Assessment, Transportation, and Resource Mission
	Mini Lunar Volatiles (MiLUV) Mission
	CubeSat X-ray Telescope (CubeX) (also applicable to NEOs and Phobos/Deimos)
	Bi-sat Observations of the Lunar Atmosphere above Swirls (BOLAS)
Small Bodies	
	CAESAR: CubeSat Asteroid Encounters for Science & Reconnaissance
	Primitive Object Volatile Explorer (PrOVE)
	APEX: Asteroid Probe Experiment
Mars	
	Aeolus - to study the thermal and wind environment of Mars
	PRISM: Phobos Regolith Ion Sample Mission
	Mars Ion and Sputtering Escape Network (MISEN)
	Chariot to the Moons of Mars
	Mars Aerosol Tracker (MAT)
Icy Bodies and Outer Planets	
	SNAP: Small Next-generation Atmospheric Probe
	JUpiter MagnetosPheric boundary ExploreR (JUMPER)

#smallsats2018

Planetary Science Deep Space SmallSat Mission Concepts

Sunday, March 18, 2018
The Woodlands, Texas
The Woodlands Waterway Marriott Hotel and Convention Center

Call for poster abstracts is OPEN!

Abstracts for inclusion in the Planetary Science Deep Space SmallSat Mission Concepts topic at LPSC are now being accepted. Abstracts may be submitted via the LPSC abstract submission process to the topic "SmallSat Mission Studies".

NASA's Planetary Science Division is considering including small secondary payloads on future launch opportunities. To help identify high-priority science objectives that could be addressed with small satellites, nineteen studies were funded to develop mission concepts. A brief overview of each of these nineteen studies will be presented at the upcoming Planetary Science Deep Space SmallSat Studies meeting on March 18, 2018. In addition, workshop participants are encouraged to submit LPSC abstracts to the poster topic described above.

Additional details are now available on the meeting website.

https://www.hou.usra.edu/meetings/smallsat2018/

Small Innovative Missions for Planetary Exploration (SIMPLEx)

SIMPLEx-2 : Overview

- Solicits formulation and development of science investigations that require a spaceflight mission that can be accomplished using small spacecraft
  - ESPA-Class or smaller (< 180Kg)
  - Solicitation for secondary payload on specific primary missions, which will determine:
    - Launch readiness date
    - Initial release trajectory
  - Cost-capped missions
  - Continuously Open call with mission-specific deadlines
  - Foreign Participation will be allowed

SIMPLEx-2: AO

- **SALMON3 – PEA:** Third Stand Alone Missions of Opportunity Notice (SALMON-3) Program Element Appendix (PEA)
- **Small Complete Missions (SCM):** Investigation that can be realized within the PEA-specific Cost Cap.
  - The term “complete” encompasses all appropriate mission phases Phase A - E, including data analysis and publication, delivery of the data to an appropriate NASA data archive, and closeout

Soon: Release Draft Open Call for proposals

On-going: Regular Panel Reviews of proposals

Research and Analysis Program

Program Name	Step-1 Due Date	Step-2 Due Date
Exoplanets (XRP)	***03/30/2017***	***05/25/2017***
Emerging Worlds (EW)	***03/30/2017***	***06/01/2017***
Cassini Data Analysis (CDAPS)	***04/06/2017***	***06/08/2016***
Solar System Obs. (SSO)	***04/06/2017***	***06/08/2017***
Laboratory Analysis of Returned Sample (LARS)	***04/26/2017***	***06/29/2017***
Planetary Data Archiving, Restoration, Tools (PDART)	***05/11/2017***	***07/12/2017***
OSIRIS REx Participating Scientist Program (ORPSP)	***05/04/2017***	***07/25/2017***
Planetary Protection Research (PPR)	***06/27/2017***	***09/28/2017***
Planetary Sci./Tech. Through Analog Research (PSTAR)	***07/25/2017***	***10/10/2017****
Exobiology (EXOB)	***08/17/2017***	***10/24/2017****
Mars Data Analysis (MDAP)	***08/24/2017***	***10/26/2017***
PICASSO	***09/22/2017****	***11/16/2017***
Discovery Data Analysis (DDAP)	***09/21/2017***	***11/21/2017***
Rosetta Data Analysis Program (RDAP)	***09/21/2017***	***11/21/2017***
Habitable Worlds (HW)	***11/16/2017***	01/17/2018
Solar System Workings (SSW)	***11/16/2017***	02/01/2018
Lunar Data Analysis (LDAP)	***11/30/2017***	03/01/2018
New Frontiers Data Analysis Program (NFDAP)	02/08/2018	05/03/2018

For updates to deadlines, see: https://science.nasa.gov/researchers/sara/grant-solicitations/roses-2017/

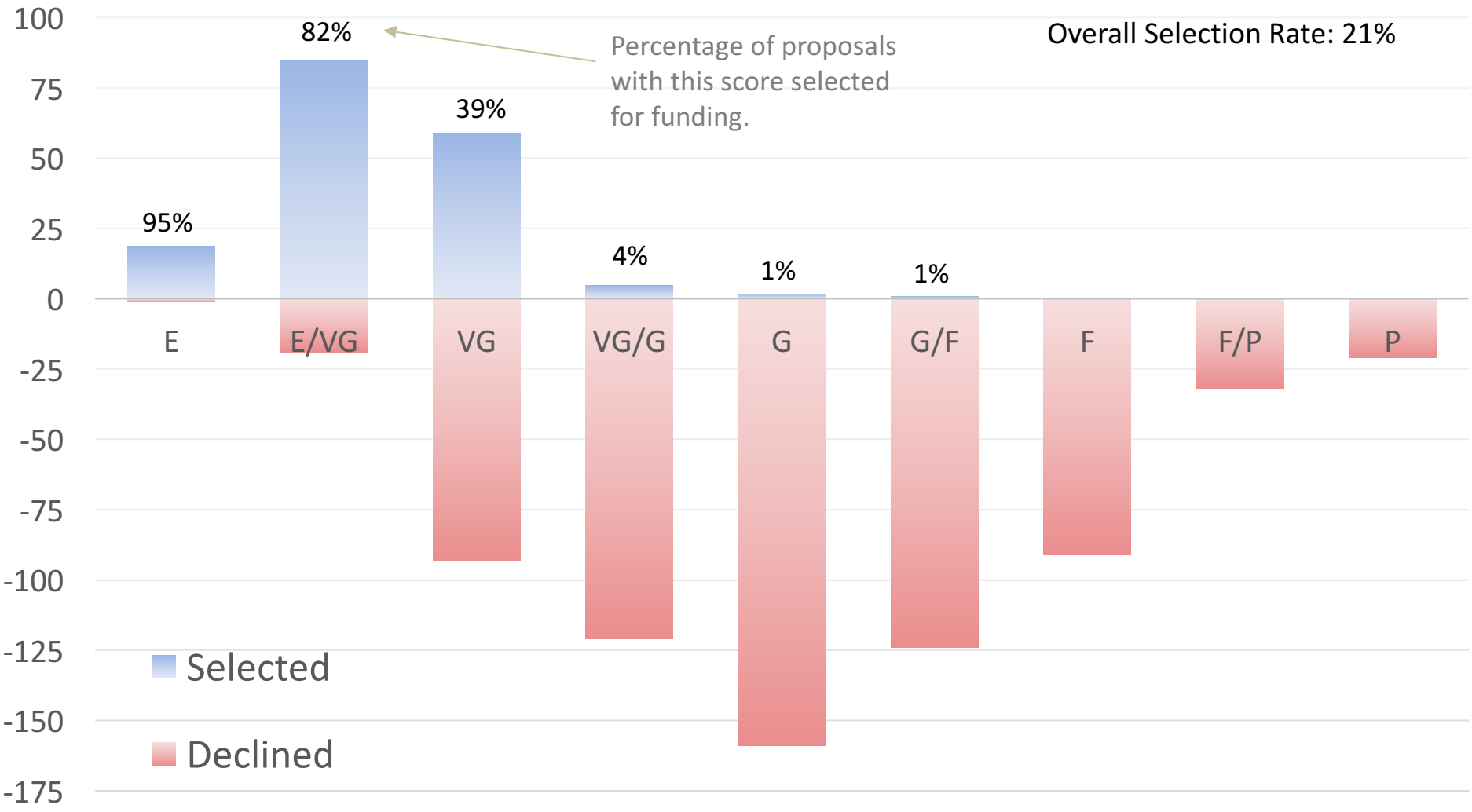
ROSES-17

- Amendment 5: Completed OSIRIS-REx Participating Scientist Program Element – Just announced – 13 scientist announced
- Amendment 44: Program element C.23, The New Early Career Fellowship Program will not be solicited in ROSES-2017
- Amendment 49: Release of C.25, The InSight Participating Scientist Program
  - Mandatory NOIs are due January 11, 2018 and proposals are due February 15, 2018.
- To be released - Amendment: E.5 Juno Participating Scientist Program Element (Joint between Planetary and Heliophysics Divisions)

ROSES-18

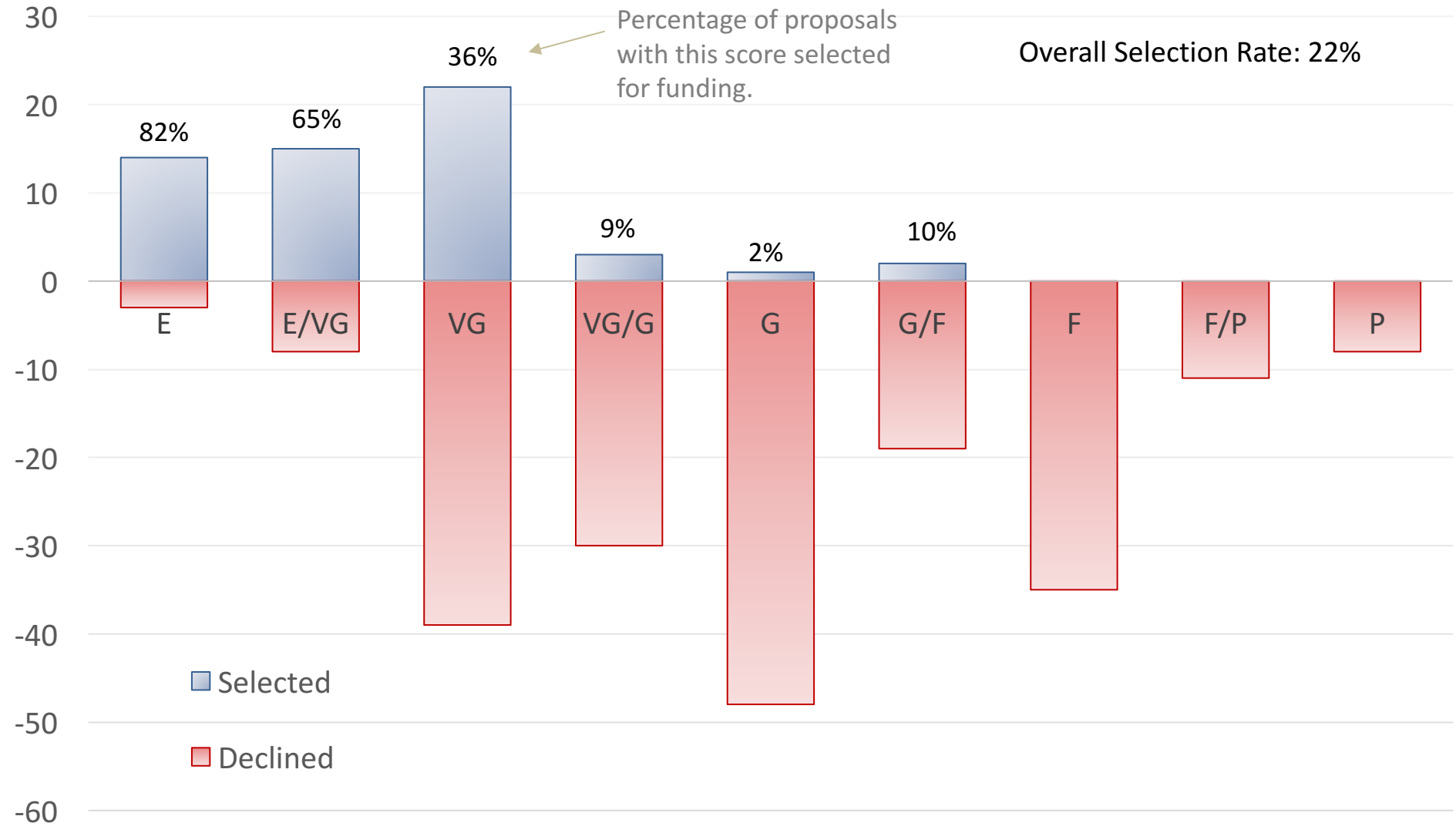
- C.15 Planetary Protection Research
- C.16 Early Career Fellowship Start-up Program for Named Fellows
- C.21 Early Career Fellowship: Initial Applications
- TBD: Korean Lunar Mission Participating Scientist Program Element

PSD R&A SELECTIONS - ROSES 2016

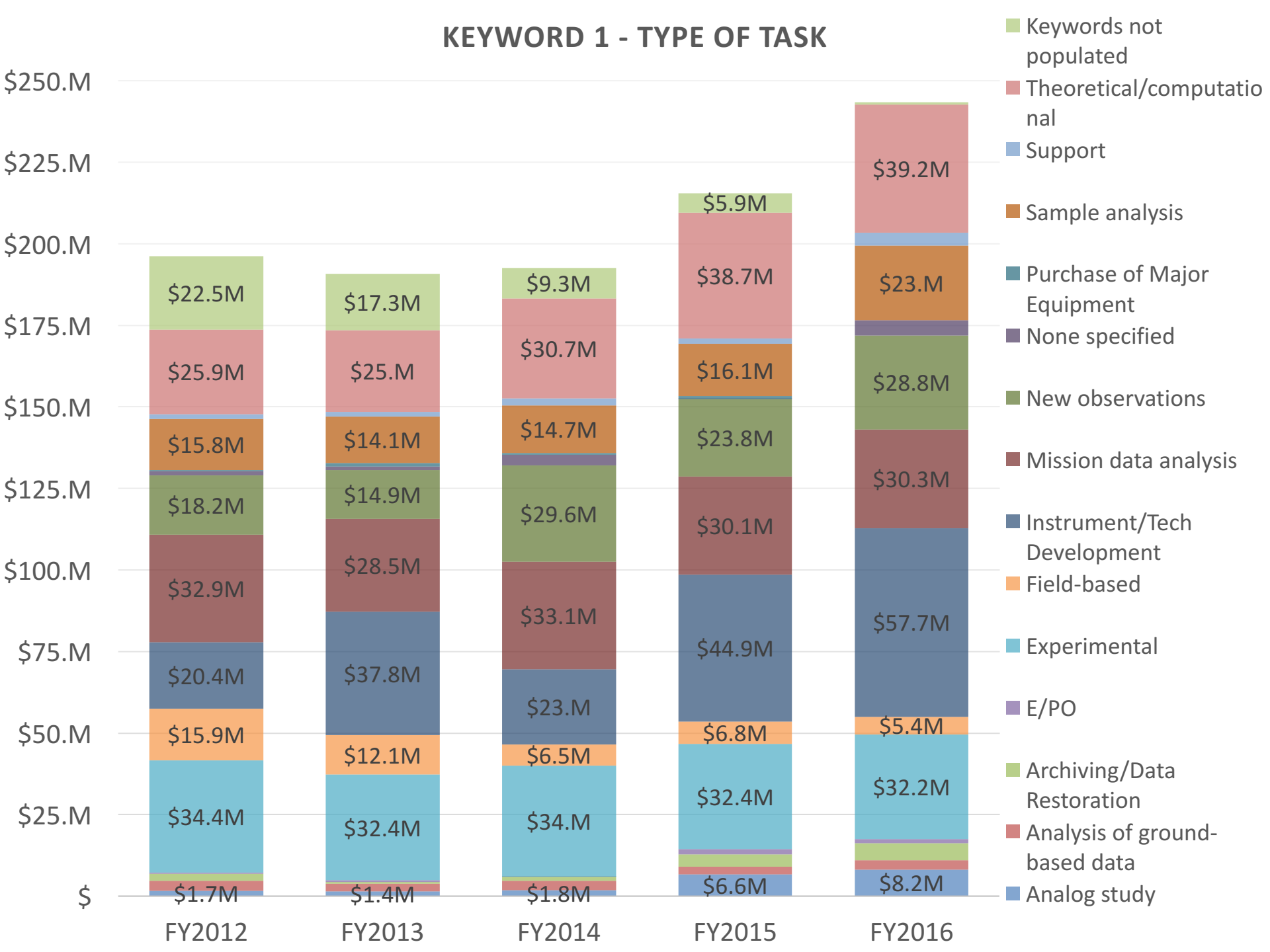


Metrics for proposals submitted to ROSES 2016, including all core programs (EW, SSW, HW, SSO, EXO) and all DAPs (MDAP, DDAP, LDAP, CDAPS).

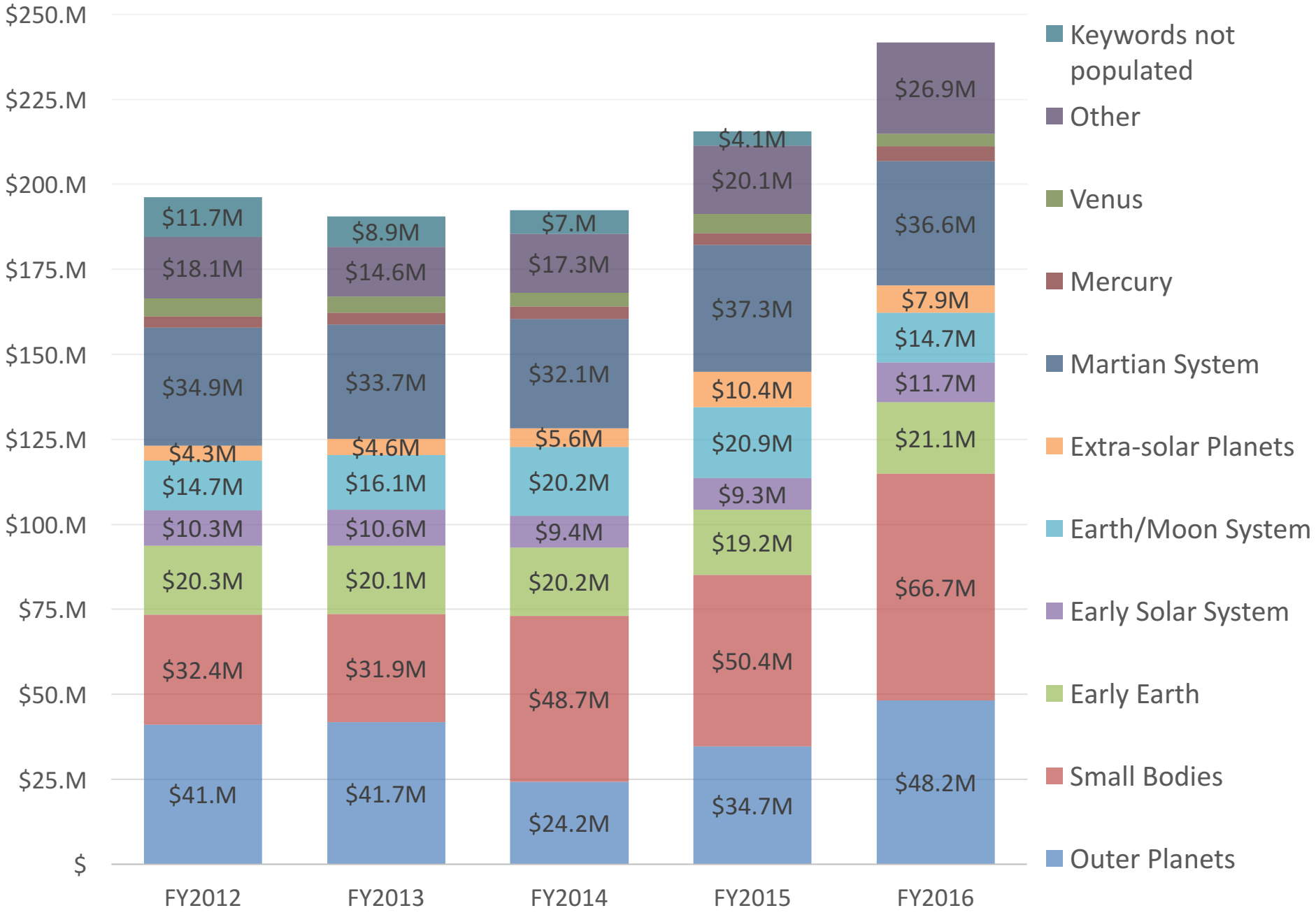
PSD R&A TECHNOLOGY SELECTIONS - ROSES 2016



Metrics for technology proposals submitted to ROSES 2016, including MatISSE, PICASSO, COLDTech, HOTTech.


KEYWORD 1 - TYPE OF TASK
$250.M
$225.M
$200.M
$175.M
$150.M
$125.M
$100.M
$75.M
$50.M
$25.M
$
FY2012
FY2013
FY2014
FY2015
FY2016
$22.5M
$25.9M
$15.8M
$18.2M
$32.9M
$20.4M
$15.9M
$34.4M
$1.7M
$17.3M
$25.M
$14.1M
$14.9M
$28.5M
$37.8M
$12.1M
$32.4M
$1.4M
$9.3M
$30.7M
$14.7M
$29.6M
$33.1M
$23.M
$6.5M
$34.M
$1.8M
$5.9M
$38.7M
$16.1M
$23.8M
$30.1M
$44.9M
$6.8M
$32.4M
$6.6M
$39.2M
$23.M
$28.8M
$30.3M
$57.7M
$5.4M
$32.2M
$8.2M
Keywords not populated
Theoretical/computational
Support
Sample analysis
Purchase of Major Equipment
None specified
New observations
Mission data analysis
Instrument/Tech Development
Field-based
Experimental
E/PO
Archiving/Data Restoration
Analysis of ground-based data
Analog study

KEYWORD 2 - TARGET BODY OVERVIEW



Science Data Management

https://www.nasa.gov/open/researchaccess

NASA-Funded Research Results

Training Videos

OSTP Policy

PubSpace

NASA-funded authors and co-authors deposit copies of their peer-reviewed scientific publications and associated data into NASA's publication repository, PubSpace.

Data Management Plan

NASA-funded extramural and intramural researchers receiving grants, cooperative agreements, and contracts for research are required to follow NASA's policy to develop data management plans as part of their NASA funding proposals. Their plans must describe how they will provide for long-term preservation of, and access to, their unclassified scientific data in digital format in NASA-approved repositories.

Astrophysics Assets for Planetary Science

JWST Cycle 1 General Observers Program (GO)

Program Category	Size	Estimated Allocation
Small programs	≤ 25 hours	3,500 hours
Medium programs	>25 and ≤ 75 hours	1,500 hours
Large programs	>75 hours	1,000 hours

- ~ 6,000 hours available
- Cycle-1 Call Supports: Calibration, Long-term, Treasurey, Survey Proposals
- Funding also available for: Archival Analysis of Data from DD ERS Programs, Theoretical Investigations and Development of Software Tools

TIME LINE	
November 30, 2017	Release of the Cycle 1 Call for Proposals
April 6, 2018	Cycle 1 Proposal deadline
June 18-22 & June 25-29, 2018	Cycle 1 Telescope Allocation Committee (TAC) Review
Late July 2018	Cycle 1 GO results released
Spring 2019	Launch

Workforce of the Future

Planetary Science Workforce Survey

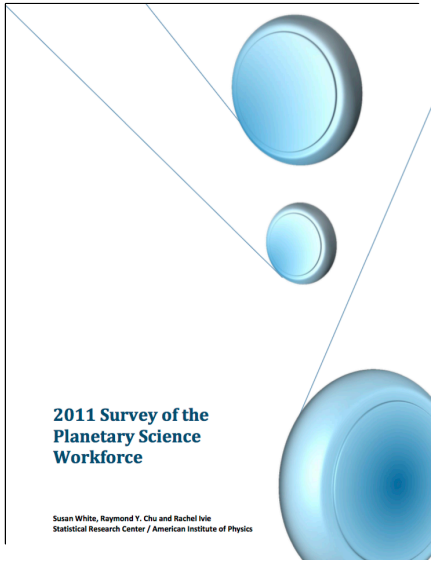


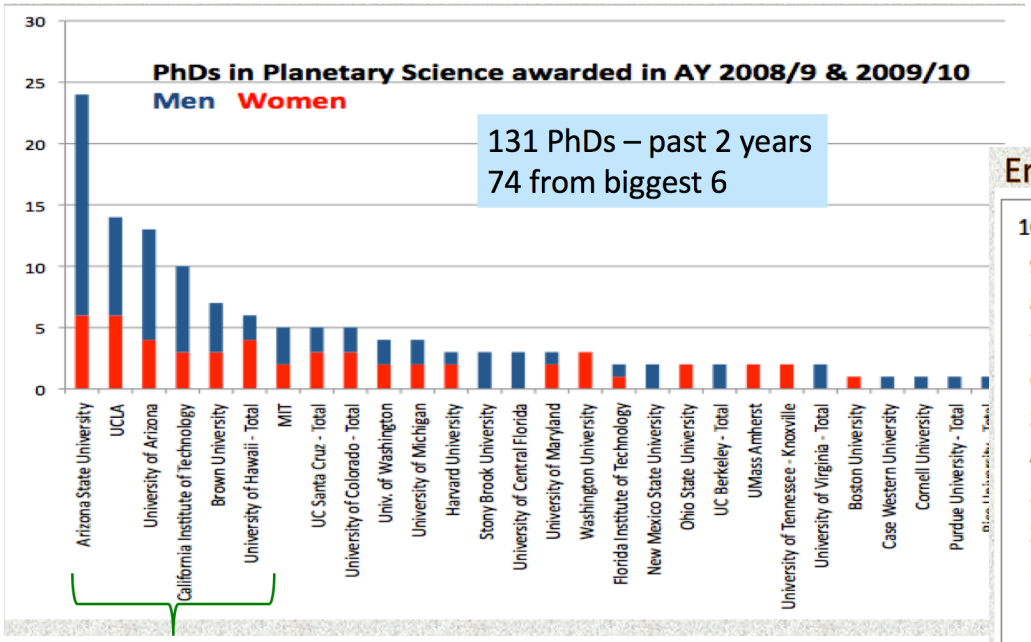
How's the workforce changing?



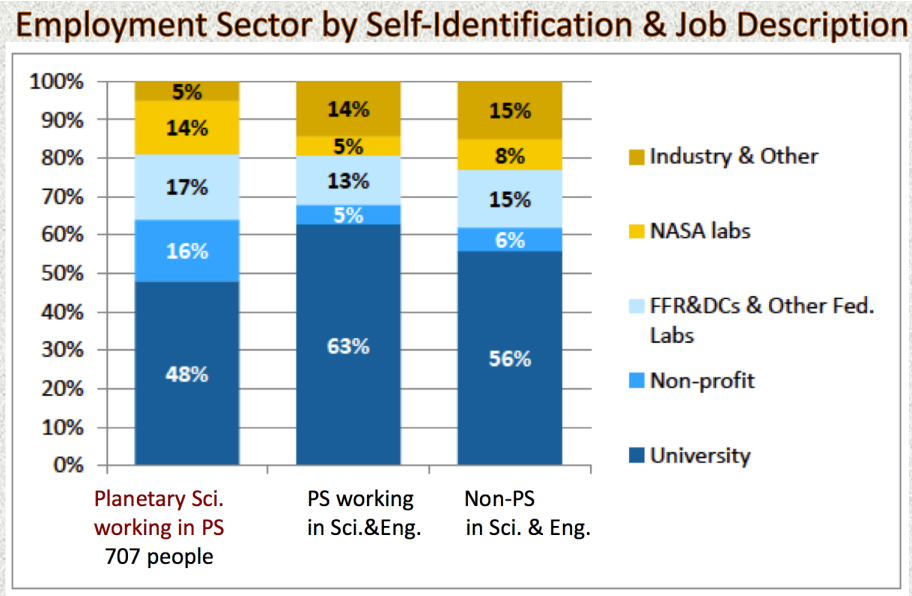

Planetary Science Workforce Survey

- What are demographics of PhD planetary scientists?
- 2011 Survey (http://lasp.colorado.edu/home/mop/files/2015/08/Report.pdf)
- NEW survey will being in 2018
- Survey Lead is Fran Bagenall
- Please participate when asked!





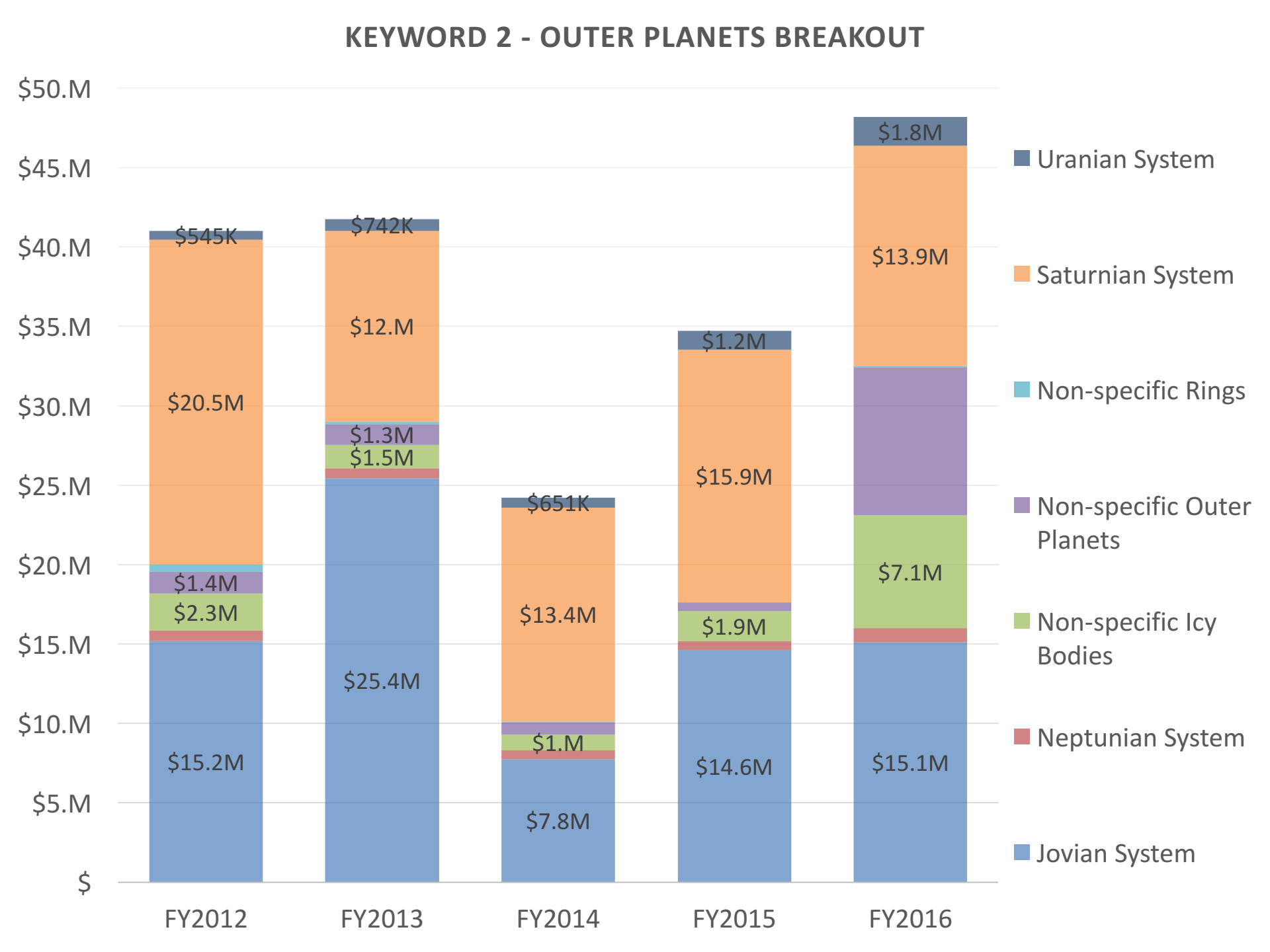
Part A – Survey 53 University Departments

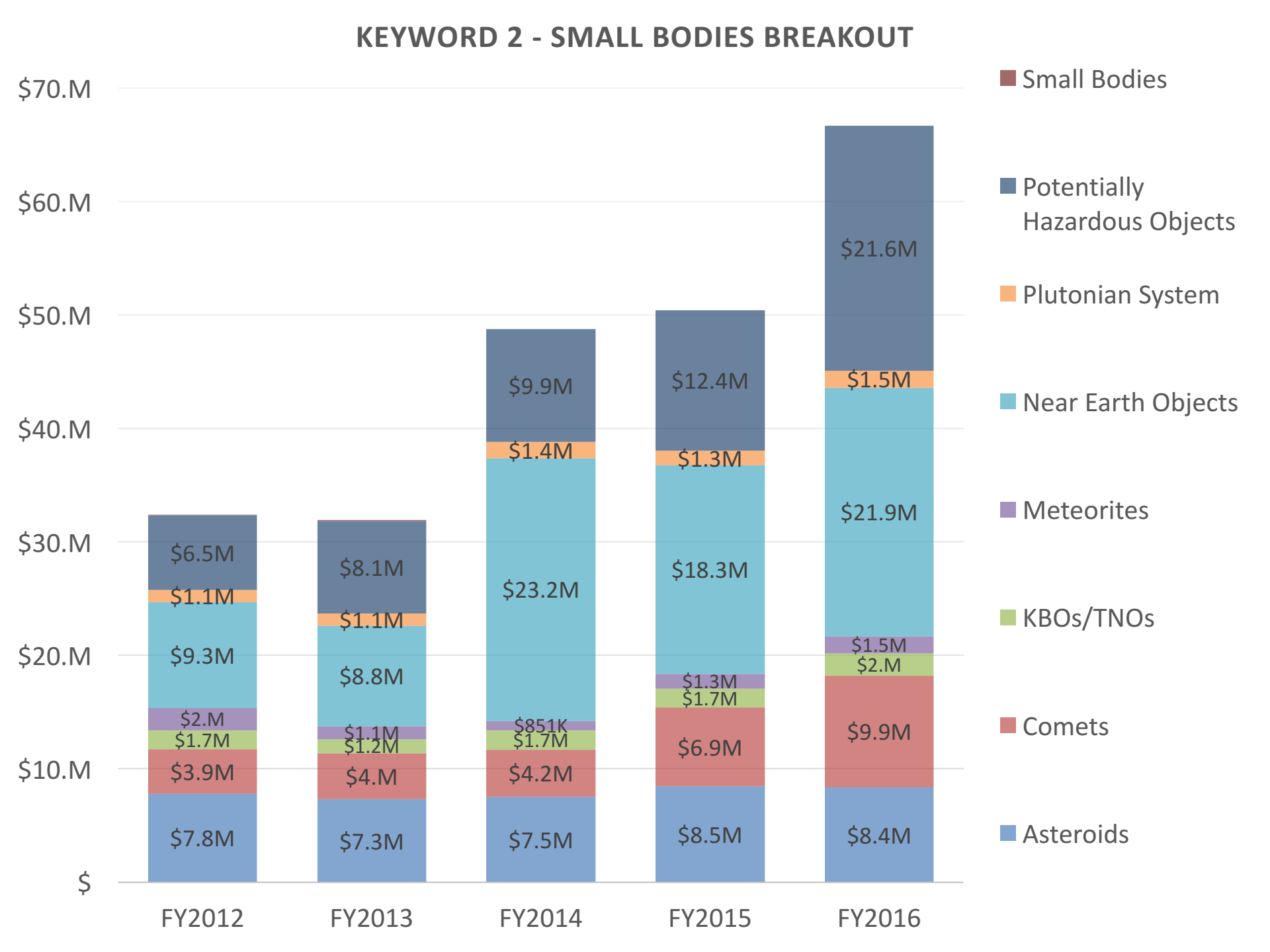


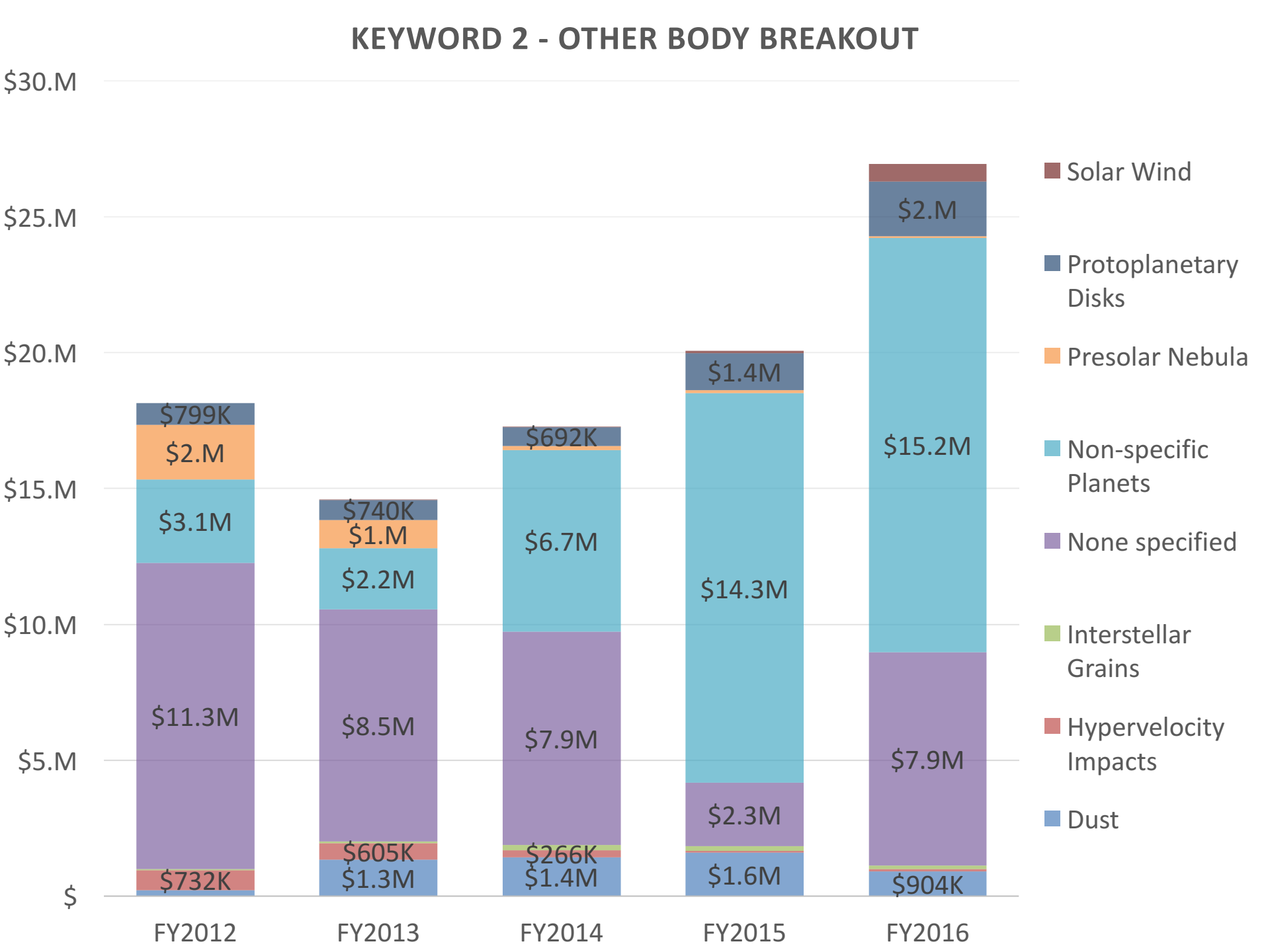
Part B – Survey 4200 AGU-DPS-LPSC attendees

Update of the Mars Program

Questions?


KEYWORD 2 - OUTER PLANETS BREAKOUT
$50.M
$45.M
$40.M
$35.M
$30.M
$25.M
$20.M
$15.M
$10.M
$5.M
$
FY2012
FY2013
FY2014
FY2015
FY2016
$545K
$20.5M
$1.4M
$2.3M
$15.2M
$742K
$12.M
$1.3M
$1.5M
$25.4M
$651K
$13.4M
$1.M
$7.8M
$1.2M
$15.9M
$1.9M
$14.6M
$1.8M
$13.9M
$7.1M
$15.1M
Uranian System
Saturnian System
Non-specific Rings
Non-specific Outer Planets
Non-specific Icy Bodies
Neptunian System
Jovian System


KEYWORD 2 - SMALL BODIES BREAKOUT
$70.M
$60.M
$50.M
$40.M
$30.M
$20.M
$10.M
$
FY2012
FY2013
FY2014
FY2015
FY2016
$6.5M
$1.1M
$9.3M
$2.M
$1.7M
$3.9M
$7.8M
$8.1M
$1.1M
$8.8M
$1.1M
$1.2M
$4.M
$7.3M
$9.9M
$1.4M
$23.2M
$851K
$1.7M
$4.2M
$7.5M
$12.4M
$1.3M
$18.3M
$1.3M
$1.7M
$6.9M
$8.5M
$21.6M
$1.5M
$21.9M
$1.5M
$2.M
$9.9M
$8.4M
Small Bodies
Potentially Hazardous Objects
Plutonian System
Near Earth Objects
Meteorites
KBOs/TNOs
Comets
Asteroids


KEYWORD 2 - OTHER BODY BREAKOUT
$30.M
$25.M
$20.M
$15.M
$10.M
$5.M
$
FY2012
FY2013
FY2014
FY2015
FY2016
$799K
$2.M
$3.1M
$11.3M
$732K
$740K
$1.M
$2.2M
$8.5M
$605K
$1.3M
$692K
$6.7M
$7.9M
$266K
$1.4M
$1.4M
$14.3M
$2.3M
$1.6M
$2.M
$15.2M
$7.9M
$904K
Solar Wind
Protoplanetary Disks
Presolar Nebula
Non-specific Planets
None specified
Interstellar Grains
Hypervelocity Impacts
Dust

NEW Discovery Missions for Flight

Planetary Defense Coordination Office

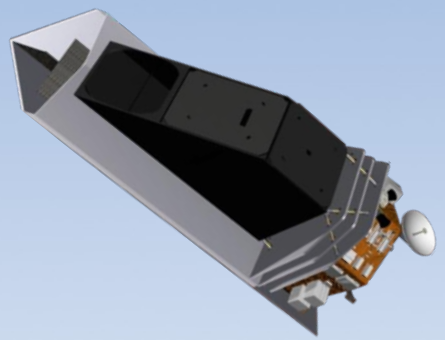
PDCO Status

- Over **17,000 near-Earth objects (NEOs)** discovered and confirmed to date
- Successful **exercise of the planetary defense system** through the campaign to recover and observe asteroid 2012 TC4 (close approach was on Oct. 12, 2017 at <8 Earth radii)
- Recently released **2017 NEO Science Definition Team Report** reassesses NEO search and characterization given current technology and understanding of the NEO population. Of the estimated 25,000 NEOs 140 meters or larger in size (that can cause regional damage), 1/3 have been found. Space-based assets will be needed to find the rest.
- Working on the **White House National Near-Earth Object Preparedness Action Plan** through Detecting and Mitigating the Impact of Earth-Bound Near-Earth Objects (DAMIEN) Interagency Working Group

PDCO Mission Projects

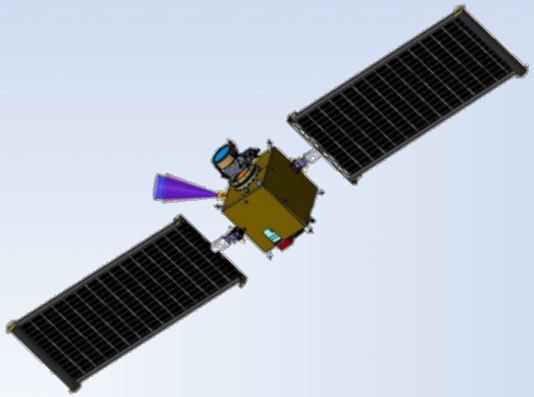
NEOWISE

- Continues in extended NEO survey operations



NEOCam: Near-Earth Object Camera

- Infrared survey telescope optimized for meeting congressional mandate to find and characterize NEOs down to 140 meters in size
- Continues in extended Phase A



DART: Double Asteroid Redirection Test

- Demonstration of kinetic impactor technique
- Target - Moon of 65803 Didymos
- Launch 2020, impact 2022
- Continues in Phase B

2.4 Million Names Going to Mars on InSight

Shareables keeps public engaged throughout the month
View slide in slideshow mode to see animated gif

InSight 2.4million names
Orion had 1.38 million
Curiosity had 1.24 million

Website Stats
Oct. 3 – Nov. 2
Page views: 12,284,063
Unique Sessions: 3,207,349

Number of boarding passes at **highest peak** submissions:
- 5.6/sec
- 336/min
- 17,281/hour
- 146,652/day (Nov. 1)

Average submissions for month:
- 38/min
- 2,236/hour
- 51,650/day